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Energy Design Assistance:
Energy Modeling Protocol
Colorado
ASHRAE 90.1-2013

Last Update: 3/3/2016

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1. General

1.1 Introduction

This document describes the Protocol for energy modeling for the Energy Design Assistance (EDA) program.

The goal of the EDA program is to provide timely results on a wide range of design options, early enough so that those options are still viable within the context of the project. The results emphasized are the *energy savings*—a differential—between options or different proposed designs and the baseline. This effort, undertaken in the design phases, does not assert an ability to forecast actual operating energy consumption, either for a proposed building or the baseline.

It is important to note that the EDA program does not attempt to provide feedback or documentation on whether or not a building is complying with the referenced energy code or standard.

For purposes of program administration, the Xcel Energy Protocol employs accepted modeling conventions, which simplify the modeling effort and provide overall consistency for our customers. This allows for our energy consultants to provide results for a wide range of possible energy savings options in a limited time period.

A computer model of a baseline design is developed for each project that has been accepted into the program. Development of the baseline building and proposed building design options follows the Protocol outlined in this document. This document primarily focuses on the Basic Energy Design Assistance service, while Enhanced is addressed separately.

This EDA Protocol is based on a utility modified version of the ANSI/ASHRAE/IESNA Standard 90.1-2013 Energy Standard for Buildings Except Low-Rise Residential Buildings utilizing Appendix *G.(Note EDA accepts low-rise multifamily projects, explained in 1.4 Protocol Standard below*). The exception to this rule is when the local energy code for the building is more stringent and/or required based on the customer/design team's decision. In all cases the ASHRAE 90.1-2013 standard baseline model shall be set up according to this Protocol and reported to Xcel Energy. For locations where more stringent local energy codes apply, the Energy Consultant is required to use an approach similar to this Protocol and document the energy savings compared with the more stringent energy code. As jurisdictions that fall under this category are discovered, appendices shall be added to the document for clarification.

Refer to local jurisdiction's websites to determine current energy code.

1.2 Scope

The purpose of this document is to specify the method for determining the proposed building performance of a customer's proposed design relative to the reference standard for the purpose of calculating energy savings results and Xcel Energy construction rebates for the EDA program.

Results are determined with the use of a computer simulation approved by Xcel Energy. Currently approved energy simulation programs are: OpenStudio/EnergyPlus.

1.3 Definitions

As Modeled	As modeled includes the savings identified within the modeled bundle during early design.
As-Specified Results	Results for a version of the building selected by the design team and owner, that is modeled according to criteria in the Protocol AND according to discretionary parameters *not* governed by the Protocol but that are set or accepted by the design team and owner during the design phase. The results are adjusted for variances found during the construction document review.
As-Verified Results	Results for a version of the building selected by the design team and owner that are modeled according to criteria in the Protocol AND according to discretionary parameters *not* governed by the Protocol but that are set or accepted by the design team and owner during construction. The results are adjusted for variances found during the verification visit.
Building Energy Model	A computer simulation of the projected energy use and associated energy costs of a building.
Baseline	The energy performance and associated energy costs developed with use of a computer representation of a hypothetical design based on the parameters defined in this Protocol.
Design Alternatives	An integrated group of strategies or energy conservation measures that represent a potential version of the building.
Energy Code	The legal requirement, as defined by a local governing agency that must be followed in designing and building the subject project. The locally adopted energy code may vary from jurisdiction to jurisdiction within Xcel Energy territory.
EDA Energy Consultant	Providers of energy modeling services.
Energy Conservation Measure (ECM)	A strategy that represents a technology, design or operation improvement for saving energy that may be considered for the subject building.
Design Team	The architects and engineers of record for designing and constructing the project.
Process Load	The load on a building resulting from the consumption or release of process energy.
Proposed Building	The building that the Design Team is planning to build without energy enhancements. ***This should be the basis for Design Alternative 1.***
Proposed Building Performance	The annual energy cost calculated for a proposed design.
Proposed Design	A computer representation of the actual proposed building design or portion thereof used as the basis for calculating the

	design energy cost.
Measurement and Verification (M&V)	For the purpose of this Protocol, M&V includes the review of a constructed building for energy conservation measures installed. Measurement is limited to selected strategies as noted in this Protocol.
Simulation Program	A computer program capable of building energy modeling on an hour-by-hour basis, (e.g. DOE 2).
Results	Energy usage and cost projections for the baseline building as compared to the modeled building versions to be considered as part of the EDA program developed using processes and rules defined in this Protocol.

1.4 Protocol Standard

The Energy Design Assistance program in Colorado uses ASHRAE Standard 90.1-2013 for commercial buildings and multifamily buildings over three stories. For multifamily buildings three stories of less, EDA uses the insulation levels prescribed in 2015 International Energy Conservation Code for residential buildings.

Specifically the EDA program uses the methodology of Appendix G with modifications listed in Section 3.2 of this document. Modifications are a result of three specific concerns surrounding Appendix G:

- Appendix G allows cross fuels: The primary metric for the Appendix G is energy costs. The accounting of what happens with individual energy units as required by Demand Side Management (DSM) programs is not an area of focus for Appendix G. The EDA Protocol adjusts this focus to meet the requirements of the DSM program. See Appendix A for the detailed policy on cross fuels policy

- Appendix G is written for use in evaluating completed designs: EDA is structured to work with participants during the early design phases before designs are finalized. This helps customers and Design Teams identify energy savings early in the design process when they have better opportunities to make design changes. Appendix G sets baseline criteria after the design decisions have been made. If the baseline is reset at the end of the design process, there can be a change in calculated savings compared to that which was forecasted in the earlier stages of design. Since Xcel Energy claims credit for the influence on design, the resetting of the baseline is not required within this Protocol unless there is a significant building change; this is thus further discussed in section 3.2 and 4.4.3.

- This EDA Protocol requires the use of the prevailing system type used in the market for that building type, taking into consideration fuel use (to avoid fuel switching). This may or may not correspond with the system as prescribed by Appendix G. If the Energy Consultant determines that the Appendix G Baseline system type does not address these requirements, the proposed HVAC system may be used in the baseline model instead, taking into consideration fuel switching. Refer to guidance on selecting systems for the Baseline in Table 3.2. The Energy Consultant will document differences from the Appendix G Baseline.

2. Simulation Requirements

2.1 Process

The Energy Design Assistance program requires an hour-by-hour energy simulation program to determine the baseline model energy use and calculate as well as savings for individual energy conservation strategies and bundles.

2.2 Software Requirements

2.2.1 Simulation Program

An hour-by-hour simulation program capable of predicting annual energy use and energy cost for a building, including both energy consumption and peak energy by fuel source.

2.2.2 Weather

A standard typical year weather file for the building location is used. Typical Meteorological Year weather files for many Colorado locations are available from http://rredc.nrel.gov/solar/old_data/nsrdb/1961-1990/tmy2/ (TMY2 files) or http://rredc.nrel.gov/solar/old_data/nsrdb/1991-2005/tmy3/ (TMY3 files). If a weather file is not available for the exact location a weather file is chosen based on proximity to the building location and or climate region.

2.2.3 Utility Rates

All utility rates used in the modeling shall be documented in the preliminary report and/or bundle report to document the values used in the model. Electric rates shall be based on the most recent rates available in the quarter the project is first modeled. Rates should be updated up until the time of bundle selection. If the project goes on hold or the design is stalled for a period of time, the Energy Consultant should update rates when the design re-starts if rates have changed by >+-10%.

2.2.3.1 Electric Rates

While many of our programs use base rates as described in our most recent filings, EDA does it differently for electric rates. Other programs are based on energy costs savings while EDA uses rates to do projections for two to three years in the future. Therefore, please use the most available electric rates possible. Use the actual Xcel Energy rate structure(s) on which the building will be when occupied. The rates account for peak, consumption, and meter charges. Any time of day or seasonal variations are also accounted for.

This information can be found quarterly at our website:
http://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/rates/CO/psco_elec_entire_tariff.pdf
Weighting winter and summer months is acceptable. For all questions, please call Xcel Energy to determine reasonableness. As always, please note any differences in rates within each report.

2.2.3.2 Gas Rates

Use an average gas rate as provided by Xcel Energy January of each year and modified for specific project circumstances for Xcel Energy retail gas customers only[1]. Monthly meter charges are included in this information provided by Xcel Energy.

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[1] Non-Xcel Energy gas customers cannot receive a gas rebate.

Gas rates can be found on Xcel Energy’s website at: http://www.xcelenergy.com/staticfiles/xe/Regulatory/Regulatory%20PDFs/rates/CO/psco_gas_entire_tariff.pdf

2.2.3.3 District Heating and Cooling Rates

Use actual district energy charges for the proposed building provided by the building owner when the project is first modeled, including demand and consumption charges as well as ratchets and seasonal variations.

2.2.3.4 Campus Heating and Cooling Rates

Use actual campus energy charges for the proposed building provided by the building owner when the project is first modeled, including demand and consumption charges as well as ratchets and seasonal variations.

3. Modeling Protocol

The energy models for the Energy Design Assistance Program are determined using this Protocol, based mainly on the ASHRAE Standard 90.1-2013 Appendix G methodology. Please note that the rating authority listed in the following tables is Xcel Energy. Once baseline is established and modeling has been conducted, the baseline should not change.

3.1 ASHRAE Standard 90.1-2013 Appendix G Assumptions and Modifications

The Baseline and Proposed models shall be simulated according to the methodology of the 90.1-2013 Appendix G with the changes outlined in Table 3.2, below. The changes with regard to the low-rise residential baseline reference the 2015 International Energy Conservation Code and only apply to the residential spaces in the building. Common areas and commercial space follow the non-residential protocol.

Table 3.2 EDA Assumptions and Modifications to Appendix G

<table>
<tr><th></th><th>Proposed Design</th><th>Non-residential and High-rise Residential Baseline</th><th>Low-rise Residential Baseline</th></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td>Occupant Densities & Load Characteristics</td><td>The number of people and heat and moisture gain per person shall be based on values suggested in the ASHRAE Handbook of Fundamentals for the modeled space types. The number of people shall be held constant between the Baseline, all strategies, ECMs, bundles and design versions.</td><td></td><td></td></tr>
<tr><td>Thermostat Settings</td><td>Baseline temperatures set points shall be as shown in the table below unless directed otherwise by the design team or owner. These set points can be used to take credit for programmable thermostats for multifamily housing projects

Table 3.1.6 Standard Temperature Set Points
<table>
<tr><th></th><th>Occupied</th><th>Unoccupied</th></tr>
<tr><td>Heating</td><td>70</td><td>65</td></tr>
<tr><td>Cooling</td><td>75</td><td>82</td></tr>
</table>
Cooling savings from ceiling fans in residential dwelling units can be modeled by increasing the cooling setpoints in the Proposed model, as follows[2]:

3°F cooling setup when ceiling fans are installed in living rooms and all bedrooms
2°F cooling setup when ceiling fans are installed in all bedrooms
1°F cooling setup when
</td><td></td><td></td></tr>
</table>

	ceiling fans are installed in living rooms only, or master bedroom only		

	Proposed Design	**Non-residential and High-rise Residential Baseline**	**Low-rise Residential Baseline**
Schedules			
	Lighting, equipment, and fan hours of operation shall be based on published data and experience from past projects and updated with input from the owners, architects, and engineers of record.	Same as Proposed Design	Same as Proposed Design
Building Envelope			
Orientation	See ASHRAE 90.1-2013 Appendix G Table G3.1, item 5, Proposed Building Performance	Same as Proposed Design	Same as Proposed Design
Opaque Assemblies			a. See 2012 IECC Tables 402.1.3, items Above-grade walls, Basement and crawl space walls and Above-grade floors for the Standard Reference Design b. Roofs shall be modeled with the same configuration (Insulation Entirely Above Deck, Metal Building, or Attic and Other) as in the proposed design, with the Assembly Maximum U-factor taken from the appropriate table in 2012 IECC Table 402.1.3 for the building's climate zone. Assume wood framing in the baseline.
Vertical Fenestration		Fenestration Area shall be modeled as stated for the Budget Building in Table 11.5.1. Fenestration U-factors and SHGC values shall match the appropriate requirements for Metal Framing (all other) in Tables 5.5-1 through 5.5-8.	Fenestration Area shall be modeled as stated for the Budget Building in Table 11.5.1. Fenestration U-factors and SHGC values shall match the appropriate requirements in 2012 IECC Table 402.1.3. For climates with no requirement (NR) for SHGC, a value of 0.40 shall be used.
Existing Buildings		Existing building properties can be modeled for the baseline, provided that: 1) The customer is not required to make a change to the assembly (roof, window, wall, etc) as part of the project. 2) The existing assembly will not need to be replaced or repaired in the near foreseeable future. If the assembly will need to be replaced within the next few years, then the baseline shall be the code minimum. 3) Either the use or occupancy of the building will not change as a result of the project.	

	Proposed Design	Non-residential and High-rise Residential Baseline	Low-rise Residential Baseline
Infiltration Rates			
	Infiltration rates are based on ASHRAE Handbook of Fundamentals 2013 Chapter 16 suggested values for the different building types. Infiltration rates are the same for the Baseline and all strategies, ECMs, bundles and design versions, unless measures are identified that have a quantifiable effect on infiltration. Infiltration strategies need to be approved by Xcel Energy before inclusion in bundle(s) for rebates.	Same as Proposed Design	Same as Proposed Design
Lighting Design			
Interior Lighting	See ASHRAE 90.1 - 2013 Appendix G Table G3.1, items 6a through 6f WITHOUT the exception under 6d, Proposed Building Performance. For Multifamily, hardwired fixtures shall be used to determine lighting power density; rooms with switched outlets only are modeled identically in the Baseline.	Lighting power in the baseline building design shall be determined by using the Space-by-Space Method described in ASHRAE 90.1 - 2013 Section 9.6 OR referencing COMCheck values as provided by the Design Team. EXCEPTION: For multi-family dwelling units assume a baseline lighting power density of 1.1 W/sf with annual usage of 750 hours per year. Rooms with switched outlets are to be modeled the same as the Proposed.	For multi-family dwelling units assume a baseline lighting power density of 1.1 W/sf with annual usage of 750 hours per year. Rooms with switched outlets are to be modeled the same as the Proposed.
Exterior Lighting	Exterior lighting shall be modeled as designed		
Lighting Controls			
Automatic lighting controls	For automatic lighting controls in addition to those required for minimum code compliance under ASHRAE 90.1 - 2013 Section 9.4, credit may be taken for automatically controlled systems by reducing the connected lighting power by the applicable percentages listed in ASHRAE 90.1 - 2013 Section 9.6.3 and Table 9.6.3. Alternatively, credit may be taken for these devices by modifying the lighting schedules used for the proposed design according to the procedure described in Appendix C of this protocol.	Baseline shall have daylighting controls as outlined in Table G3.1, item 6 and Section 9.4. See ASHRAE 90.1-2013 Addendum	
Manual lighting controls	a. Credit may be claimed for installing dual-level fixtures (fixtures in which individual lamps are switched separately to provide two or more levels of light) according to the procedure described in Section 3.4.12.3 of this protocol.	See ASHRAE 90.1-2013 Appendix G Table G3.1, item 6, Baseline Building Performance	

	Proposed Design	Non-residential and High-rise Residential Baseline	Low-rise Residential Baseline
HVAC Systems			
System Type	See ASHRAE 90.1 - 2013 Appendix G Table G3.1, items 10a and 10b, Proposed Building Performance	The HVAC system(s) in the baseline building design shall be of the type and description specified in section 3.2.1 of this protocol.	The HVAC system(s) in the baseline building design shall be of the type and description specified in section 3.2.1 of this protocol.
Equipment Efficiencies	a. HVAC equipment efficiencies shall be modeled at the design efficiency levels. b. Where efficiency ratings, such as EER and COP include fan energy, the descriptor shall be broken down into its components so that supply fan energy can be modeled separately. EXCEPTION: If the supply fan does not supply outdoor air and is modeled as cycling during both occupied and unoccupied hours, the fan energy may be included in the overall efficiency rating and not modeled explicitly.	a. All HVAC equipment in the baseline building design shall be modeled at the minimum efficiency levels, both part load and full load, in accordance with ASHRAE 90.1 - 2013 Section 6.4 b. Same as Proposed Design	a. All residential HVAC equipment in the baseline building design shall be modeled at the minimum efficiency levels, both part load and full load, in accordance with ASHRAE 90.1 - 2013 Section 6.4 or Federal minimum requirements for equipment in low-rise residential, whichever is higher. b. Same as Proposed Design
Supply Fans	Outside air dampers shall be assumed to be closed when the fans are scheduled off (5% leakage) and fans cycle on as needed to maintain unoccupied temperature settings. **Fan energy peak demand** can be verified through a review of the test, adjust, and balance (TAB) report, if available, along with fan motor data logging. To verify demand savings through fan motor data logging, fan motor amp draw, fan airflow volume and duct static pressure can be monitored either from the BAS or independent data logging. If the fan does not run at full speed during the trending period, fan laws can be used to calculate peak fan kW from operational kW. Measured fan peak kW should then be compared to the calculated baseline kW to verify estimated peak fan kW savings in the energy model.		
Ventilation	Ventilation rates shall be as designed or, where not specified, modeled according to the space type ventilation requirements in ASHRAE 62.1 - 2013 Tables 6-1 and 6-4. See See ASHRAE 90.1 - 2013 Appendix G paragraph G3.1.2.6 exceptions to account for reduction and increase in ventilation requirements in proposed design. If proposed design has a DOAS and is being compared to a multi-zone system (e.g. VAV or PVAV), the design may be modeled with lower ventilation than baseline as long as ventilation calculations are shown baseline PVAV/VAV system.	Same as Proposed Design.	Same as proposed design.
System-specific Requirements	Underfloor air distribution systems and thermal displacement ventilation systems shall be modeled according to the procedure documented in section 3.4.10 of this protocol. **If modeling a system type that is not addressed by this protocol, please contact the Program Implementer for guidance.**	See ASHRAE 90.1 - 2013 Appendix G paragraph G3.1.3 EXCEPTION: the same cooling energy source shall be used in the baseline model as in the proposed design. For example, if natural gas-driven absorption chillers are used in the proposed design, gas absorption chillers must also be used in the baseline model. Where the proposed design uses electrically-driven chillers (either air-cooled or water-cooled), water-cooled chillers shall be used in the baseline, with the size and number of chillers determined by ASHRAE 90.1 - 2007 Table G3.1.3.7.	See ASHRAE 90.1 - 2013 Appendix G paragraph G3.1.3

	Proposed Design	Non-residential and High-rise Residential Baseline	Low-rise Residential Baseline
Service Water Heating			
Pools	Interior pool water heating equipment may be modeled as designed. Exterior Pool water heating equipment may not be included.	Interior pool water heating equipment may be modeled according to ASHRAE 90.1-Section 7.4.5, with minimum efficiencies listed in Table 7.8	Interior pool water heating equipment may be modeled according to ASHRAE 90.1-2013 Section 7.4.5, with minimum efficiencies listed in Table 7.8
Receptacle and Process Loads			
	Receptacle loads, such as those for office or other equipment, shall be determined by the modeler's professional judgement or taken from the 2005 California Energy Commission Non-residential Alternative Calculation Method (ACM) Approval Manual Table N2-3, based on the space type category. Values other than the 2005 California Energy Commission Non-residential Alternative Calculation Method (ACM) Approval Manual Table N2-3 must be validated by the engineers of record and **approved by Xcel Energy before inclusion in energy alternatives/bundle(s) for rebates.** Projects types such as labs and hospitals that may have large plug loads can be disadvantaged if the plug loads are not available for energy savings due to the EDA program limitations. On a per project basis and approved by Xcel Energy, exceptions can be made to separate the plug load from the total energy savings and use this as the final requirement for minimum savings. Types of plug load examples: • Computers/monitors, laptops, IPADs • Hospital plug-in equipment • Coffee makers, refrigerators, microwaves, dishwashers • Clothes washers • Fans • Desk and table lamps • Televisions Process energy is that which is consumed in support of a manufacturing, industrial, or commercial process other than conditioning spaces and maintaining comfort and amenities for the occupants of a building. Buildings with sizeable process loads such as data centers and other process end uses (examples below) that are not regulated by ASHRAE 90.1-2013 shall document the baseline and ECM parameters used in the energy model as *Exceptional Calculation Methods* as described in Appendix G. Types of process energy examples: • Cooking • Special HVAC, process systems • Hospital systems • Special motor driven systems	Same as Proposed Design	Same as Proposed Design

	• Data centers[3] • Exhaust systems • Refrigeration systems[4] Many times these process systems can be integrated with the building services and reduce the overall energy consumed. An example would be the use of hot gas from a refrigeration system to preheat service water. While the modeling of these particular process loads is not defined by this Protocol, Xcel Energy has significant documentation on these areas and should be notified regarding their use. Please contact Xcel Energy to discuss process loads prior to modeling completion, as Xcel has process loads experience. When process loads are estimated during the time of early modeling, Xcel Energy requests that these loads be updated if significant changes are made during design and if prior knowledge of these changes occurs before Construction Document Review. Final rebate estimates are not provided to the customer until after this time.		
Receptacle Control	Required in offices, conference rooms, … Occupancy control of switched receptacles also required in hotels and motels	Same as Proposed Design	Same as Proposed Design

3.2.1 Mechanical System Selection

The Baseline mechanical system shall be determined according to the methodology of ASHRAE 90.1-2013 Appendix G paragraph G3.1.1 with the following modifications:

i. For Systems 5 through 8, each floor may be modeled with a separate air handling system. Alternatively, the baseline model may have the same number of air-handlers with the same zone assignments as the proposed design.
ii. If portions of the building are heated entirely by gas and portions of the building are heated entirely by electricity and there is no overlap then G3.1.1a shall be modified to read:
    a. Additional system type(s) may be used for non-predominant conditions (i.e., residential/nonresidential or heat source) if those conditions apply to more than 5,000 ft2 of conditioned floor area.
iii. If Exception b. under G3.1.1 is utilized and System 3/System 4 is used to serve the unique space, the system(s) serving the remaining portions of the building shall be determined based on the size of the remaining areas.
iv. The Baseline efficiency for System 1 – PTAC shall refer to ASHRAE 90.1 – 2013 Table 6.8.1-4. If project is using SPVAC as baseline, then model baseline as SPVAC. If project is using PTAC as baseline, then model baseline as PTAC.

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[3] Please note that Xcel Energy does have a Data Center Efficiency program and whenever possible, customers should combine efforts between Energy Design Assistance and this program.

[4] Baseline refrigerated display merchandisers shall be modeled as outlined by the Department of Energy document 10 CFR Part 431 and ANSI/AHRI Standard 1200-2013.

v. If portions of the buildings are heated by multiple fuel sources, due to the fuel switching concern, a "Mixed Fuel" category is available in Table 3.2.2. The intent of this category is to use the same fuel type allocation in the same sequence in the Baseline as in the Proposed Design. If the multiple fuel sources can be mapped directly to that Baseline system (e.g. main AHU gas heat, electric reheat, electric baseboards) do so. For the purpose of establishing the Baseline system, ground-coupled loops are deemed to be electric in the Baseline as the heat pumps that utilize the loop are electrically–driven. Loads served by solar thermal energy in the design shall be served by their backup fuel in the Baseline
    a. Mixed Fuel Heating Example 1 - *75,000 sf school building, 2 floors*
        i. *Proposed Mechanical System: Ground-coupled heat pump with gas-fired DOAS.*
        ii. *Baseline Mechanical System: Modified System 5 - Packaged VAV with gas boiler preheat and main heating coils, electric resistance zone reheat.*
    b. *Mixed Heating Fuel Example 2 – 100,000 sf Multi-family residential, 3 floors.*
        i. *Proposed Mechanical System: Water to air heat pumps served by gas boiler and cooling tower.*
        ii. *Baseline Mechanical System: Modified System 1 PTAC with hot water serving residential units, Modified System 3 – PSZ with hot water serving common areas. Hot water consists of gas and electric boilers staged so that gas and electric heating in the Baseline are proportional to the Proposed mechanical system.*
    c. *Mixed Heating Fuel Example 3 – 100,000 sf office with electric reheat*
        i. *Proposed Mechanical System: gas-fired PVAV with electric reheat*
        ii. *Baseline Mechanical System: Modified System 5 - Packaged VAV with gas boiler preheat and main heating coils, electric resistance zone reheat.*

Table 3.2.2 Baseline HVAC System Types

Building Type	All Fossil Fuel	All Electric or Ground Loop Heat Pump Heat	Mixed Heating Fuels*
Residential	System 1--PTAC	System 2--PTHP	Modified System 1--PTAC with hot water coil. Boilers should be sized proportionate to fuel uses and staged the same as the proposed design. If proposed design uses hot water, follow Appendix G requirements for pump energy. If proposed design does not have pumping energy, model the hot water loop with zero pump head in the baseline. If the proposed design includes a DOAS system, the baseline may be modeled with a DOAS of similar fuel type. Follow ASHRAE 62.2-2013 for ventilation requirements in apartments. Ventilation may be supply only, exhaust only or supply and exhaust (balanced). Model identically in baseline and proposed. Credit can be taken for more efficient supply and exhaust fans in the proposed design.
Nonresidential and 3 floors or less and <25000 ft^2	System 3--PSZ, AC	System 4--PSZ-HP	Modified System 3--PSZ with fossil fuel furnace. If the proposed design includes a DOAS system, the baseline preheat coil and main air handler heating coil fuel types should match that of the DOAS, terminal reheat fuel source shall be the same as design.
Nonresidential and 4 or 5 Floors and <25,000 or 5 Floors or less and 25,000 to 150,000 sf	System 5--Packaged VAV with Reheat	System 6--Packaged VAV with PFP Boxes	Modified System 5--Packaged VAV. Boilers should be sized proportionate to fuel uses and staged the same as the proposed design. If the proposed design includes a DOAS system, the baseline preheat coil and main air handler heating coil fuel types should match that of the DOAS, terminal reheat fuel source shall be the same as design.
Nonresidential and More than 5 Floors or >150,000 sf	System 7--VAV with Reheat	System 8--VAV with PFP Boxes	Modified System 7--VAV. Boilers should be sized proportionate to fuel uses and staged the same as the proposed design. If the proposed design includes a DOAS system, the baseline preheat coil and main air handler heating coil fuel types should match that of the DOAS, terminal reheat fuel and radiant zone heat source shall be the same as design.
Retail, Warehouse and Manufacturing; 2 floors or less	System 3--PSZ, AC	System 4--PSZ-HP	Modified System 3--PSZ with hot water coil. Boilers should be sized proportionate to fuel uses and staged the same as the proposed design. Each thermal block shall be modeled with its own HVAC system. If the proposed design includes a DOAS system, the baseline preheat coil and main air handler heating coil fuel types should match that of the DOAS, terminal reheat fuel source shall be the same as design.
Heated Only Storage	System 9 - Heating and Ventilation (Furnace - gas fired, constant volume)	System 10 - Heating and Ventilation (Furnace - electric, constant volume)	Modified System 9--Heating and Ventilations system with hot water coil. Boilers should be sized proportionate to fuel uses and staged the same as the proposed design. If the proposed design includes a DOAS system, the baseline preheat coil and main air handler heating coil fuel types should match that of the DOAS, terminal reheat fuel source shall be the same as design.

*If the mixed heating fuel system does not seem like it will maintain a similar allocation of fuel usage between the Baseline and Proposed Please contact the Program Implementer

3.3 Enhanced Energy Design Assistance

The EDA Enhanced program track provides energy consulting services early in design. This program also provides energy modeling support where design teams have a stated goal for achieving certification with other 3rd party verified rating systems, such as Designed to Earn the ENERGY STAR, LEED® and Enterprise Green Communities

When energy modeling and consulting is provided in early schematic design phases, the building design has the potential for more energy savings with optimization strategies that are applied later in the process. It is possible that the building has additional savings for design decisions made at this stage such as in an appropriate building massing strategy. The results due to such early design decisions shall be reflected in the way savings increase due to a more efficient overall building design through better daylighting, thermal zoning, etc. The savings shall be reflected in the calculations done using the defined Protocol. No separate, additional savings shall be claimed for these early design analysis decisions that are not regulated by the ASHRAE 90.1 Standard.

For projects pursuing certification options with a different baseline requirement than the EDA baseline, two baselines and two versions of the as-specified and as-verified models shall need to be run: (1) for claiming energy savings under the EDA program and providing customer rebates, and (2) for certification analysis. As part of the consulting process provided under the Energy Design Assistance program, it is the responsibility of the Energy Consultant to provide clarity in the presentation of the results so as not to confuse the design team and owners, while meeting the requirements of Xcel Energy for internal documentation and consistency of results. It is also the responsibility of the Energy Consultant to be familiar with the current requirements and interpretations thereof associated with the certification effort approved by Xcel Energy for the subject project, and to follow those requirements for the subject project. Program Requirements can be found at www.xcelenergy.com/businessnewconstruction.

3.4 Special Baseline Considerations

3.4.1 Cross-Fuel Policy for Colorado

Cross-fuel - Baseline systems shall be selected to eliminate the situation where an end use's energy source is changed from one energy stream to a different energy stream in the bundle. The Cross-fuel policy in Colorado, according to regulations is: "Fuel switching from natural gas to other fossil fuel derived energy sources shall not be included in the gas utility's DSM program. Programs to save natural gas through switching to renewable energy sources such as solar heating and ground source heat pumps are allowed." Xcel interprets this rule to mean switching from electricity sources to other fossil fuel sources as well.

An example of an allowable fuel switching is where a customer implements a ground source heat pump strategy which will reduce gas consumption but increase electric consumption. Calculations for cross fuel, savings and an incentive shall be followed in accordance with the policy attached in Appendix A of this protocol.

An example of what is fuel switching but NOT allowable is where a customer implements a gas-fired absorption chiller instead of an electric chiller which will reduce electric consumption but increase gas consumption. To avoid fuel switching, an appropriate baseline for this system would be a gas fired absorption chiller modeled with an efficiency equal to that prescribed in the protocol. In the case where a project is considering a number of systems for a given strategy, it may be necessary to create multiple baseline models in order to prevent incentives for fuel switching.

3.4.2 Load Shifting

CO – Load shifting shall be defined as a measure that shifts electrical energy and demand usage to an off-peak period, without reducing the total load served over a defined time period (for example, one day or one week). Energy consumption to meet the loads of the affected end use shall not be significantly reduced. Example load shifting measures include thermal energy storage (examples - ice storage, chilled water, or eutectic solutions) and equipment rescheduling. Peak shaving and demand control technologies (for example, lighting voltage reduction) shall not be classified as load shifting if they reduce the total load being served.

Load shifting strategy results shall be developed as an independent modification and **shall be reviewed by Xcel Energy** for potential eligibility for inclusion in incentive calculations. (See Appendix B for specific policy and calculation details.)

3.4.3 On-Site Generation/ Renewable Energy

On site generation including co-generation, on-site wind, or photovoltaic (PV) systems shall not be rebated through the EDA program as they are not deemed "conservation" by Xcel Energy. While the overall impact of these systems should be analyzed for the overall building, switching from one source to another is considered fuel switching.

3.4.4 Solar Thermal Systems

Projects including solar thermal systems for heating of service hot water, building heat or pool water heat can include the solar thermal system's energy savings in the model. However since the DOE-2 program does not currently support the direct calculation of solar thermal systems, the consultant shall document in the project report(s) the methodology of calculating the energy savings of these systems. Multiple software packages are available to analyze solar thermal systems. Calculations are required to be based on 8,760 hours per year weather file for the project location as described in Section 2.2.2; and heating load calculated from DOE-2 for the service hot water, building heating water, or pool water heating load from the project's DOE-2 run. In order to avoid incentives for fuel switching, the solar thermal system energy savings shall be of the same fuel type as the backup or supplemental heat source designed for that heating end use. For the solar thermal system, if there is no back up fuel source, the baseline system shall be electric heat if the rest of the building is all-electric and natural gas fired if the building has a gas line for other uses.

3.4.5 District Heating Systems

Projects that shall use district heating (ie. purchased steam heat) shall use the following methodology to determine the district component of the natural gas savings impacts for the project. All energy simulations runs shall use district heating as the source for heating. The difference between the baseline model annual heating energy use and the proposed bundle annual heating energy use shall be divided by 80%. The district component of the natural gas savings shall then be added to the building natural gas savings, the sum of these two shall comprise the total natural gas savings that the incentive is based on. The project is only credited an incentive for saving natural gas if the district system uses Xcel Energy's retail gas.

The previous methodology is developed to approximate the energy savings without detail information on the district heating system. The true differential energy performance cannot be determined without detailed knowledge and even simulation of each system's equipment and operation. For the EDA program, we determine an energy value that can be assigned to these load reductions for purposes of calculating an incremental incentive.

3.4.6 District Cooling Systems

Projects that shall use district cooling shall use the following methodology to determine the district component of the electricity use and demand savings impacts for the project. All energy simulations runs shall use district cooling as the source for cooling. The cooling energy use and demand reductions from the EDA baseline to the proposed bundle are used to calculate kW and kWh savings based on a default baseline assumed efficiency of the respective system. The difference between the baseline model peak cooling energy use and demand and the proposed bundle peak-cooling energy use and demand shall be determined using a default efficiency of 0.58 kW/ton and 0.58 kWh/ton (if the actual district cooling plant efficiency is not known). EC's should make every effort to identify actual efficiencies. The district cooling electricity use and demand savings shall then be added to the building use and demand savings, the sum of these two shall comprise the total demand savings that the incentive is based on. The project is only credited an incentive for saving electricity if the district system uses Xcel Energy's electricity.

The previous methodology is developed to approximate the energy savings without detailed information on the district cooling system. The true differential energy performance cannot be determined without detailed knowledge and even simulation of each system's equipment and operation. For the EDA program, Xcel Energy determines an energy value that can be assigned to these load reductions for purposes of calculating an incremental rebate.

3.4.7 Campus Heating Systems

Buildings or additions to buildings that are added to an existing heating plant that is not being updated or to a central campus heating plant that serves buildings or areas not in the study shall use the same modeling approach as the listed in Section 3.4.5 for District Heating Systems. Condenser water loop system should be modeled in the baseline and proposed models. The fan power and pump power should be the same between the baseline and proposed models for the condenser water loop system.

3.4.8 Campus Cooling Systems

Buildings or additions to buildings that are added to an existing cooling plant that is not being updated or to a central campus cooling plant that serves buildings or areas not in the study shall use the same modeling approach as the listed in Section 3.4.6 for District Cooling Systems.

3.4.9 Ground Source Heat Pump Systems

Refer to table 3.2

3.4.10 Underfloor Air Distribution and Thermal Displacement Ventilation

Projects using underfloor air distribution (UFAD) or thermal displacement ventilation (TDV) HVAC systems shall use the following modeling methodology for modeling in energy simulations.

Adjust the amount of internal gain to the space from the baseline case with all lighting, people, and equipment loads assigned to the space, to a case were a portion of the loads are assigned to the plenum or return air duct. This is to account for the stratification of the internal heat gain that is not in the occupied zone.

	Percent Load to Space		Percent Load to Plenum/Return Duct	
	Underfloor Air Distribution	Thermal Displacement Ventilation	Underfloor Air Distribution	Thermal Displacement Ventilation
People	75%	67%	25%	33%
Lights	67%	50%	33%	50%
Equipment	67%	50%	33%	50%

Adjust the minimum supply air temperature from the traditional 55°F for overhead systems, to the 60°F to 67°F used in the UFAD or TDV system design. The minimum supply air temperature set point shall be obtained from the engineer of record and match the supply air temperature that the project shall be designed to use.

The outside air quantity provided to the zone is allowed to be different from the baseline overhead supply system since the ventilation effectiveness is greater with the UFAD or TDV systems. The baseline system outside air for the overhead supply system should be obtained from the engineer of record if available.

The supply air quantity of the UFAD or TDV system is allowed to be different from the baseline overhead supply system designed for a 20°F ΔT. The baseline system supply air for the overhead supply system should be obtained from the engineer of record.

3.4.11 ENERGY STAR® Rated Equipment

Projects that shall be installing new appliances and equipment can include the energy savings of the ENERGY STAR rated equipment in the model. The baseline shall use comparable sized appliance or equipment that just meets the minimum efficiency rating of the appliance or equipment

3.4.12 Lighting Control Savings ASHRAE 90.1-2013 has expanded requirements for lighting controls that should be reviewed and applied to a project before additional savings are claimed. Reference section 4.4.1.b for more information regarding documentation requirements.

3.4.12.1 Occupancy Sensors

- Modeled as schedule changes
- Schedules changed differently to account for peak savings versus annual hour savings
- Two different types of occupancy sensors are modeled although not all are applicable for all space types (additional savings can only be claimed for spaces that are not required by mandatory provisions to have occupancy sensor or dual level occupancy sensor control of lights).
    - **Occupancy sensor control** is appropriate for most space types where it is common for lights to be on when no one is present for periods throughout the day. To reduce “False-On’s” the sensor should not view out a door or into adjacent spaces. A wall switch is still required to allow occupants to turn lights off when space is occupied.

Dual level occupancy sensor control of lights is applicable for smaller enclosed spaces. The control comprises an occupancy sensor with two switches that control two separate lighting circuits in the room. The circuits connect separate fixtures in the space or separate lamps in each fixture. As the wall-mounted sensor detects occupancy, it switches ‘on’ one of the lighting circuits. The other circuit has to be manually turned 'on'. If no occupancy is detected for an extended period, the occupancy sensor switches 'off' both circuits. If the space has access to daylighting, the savings can increase further.

3.4.12.2 Vacancy Sensors

- Vacancy sensors are occupancy sensors that require manual-on versus auto-on. Studies show that vacancy sensors achieve 21% savings as compared to 10% for standard occupancy sensors[5]. Based on this, Xcel Energy allows for an additional 11% more energy and demand rebate credit beyond the Appendix C tables.
    - Proper documentation must be provided (see section 4.4.1b for more information) for additional savings to be claimed. For example, a LINE voltage toggle switch with a ceiling mounted vacancy sensor does not truly operate in vacancy mode.

3.4.12.3 Dual Level Fixtures

- Dual level fixture use is applicable for rooms with variable light level requirements Manual switches should provide two or more levels of light output from EACH fixture, and must be readily accessible and located such that occupants can see the controlled lighting from the switch location. The controlled lighting should have at least one control step between 30% and 70% (inclusive) of full lighting power in addition to all off. This can be accomplished by inboard/outboard lamp switching or stepped ballasts.

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- Gymnasiums are modeled as 30% reduction on both peak and annual hours.
- All other space where applicable are modeled as 15% reduction on both peak and annual hours.

3.4.13 Adjustments

The goal of the EDA program is to provide timely results on a wide range of design options, early enough so that those options are still viable within the context of the project. We acknowledge that the window of opportunity to complete this is often very short and therefore assumptions shall need to be made in early modeling on such things as window area, ventilation rates and process load. These assumptions are made to allow for timely comparative analysis so that the customer is able to make decisions on energy efficiency and take advantage of potential incentives. Discretionary parameters are always an estimate until the building is completed and operating for an extended period in time. As such, while discretionary parameters may change throughout the process, the savings and incentives are determined based on the initial moment in time and as such should not be adjusted unless physical changes occur.

Adjustments for physical changes in the building such as square footage, window area, equipment governed by this Protocol should be made if the results are expected to be affected in a significant way. It is the

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[5] This is the basis for Title 24 calculations in a report by HMG titled "Savings Estimates for Lighting Controls and Interactions", 2012.

responsibility of the Energy Consultant to monitor the progression of design during the design, CD review and M&V stages of the EDA process and make adjustments to the baseline or alternate versions of the building such that the results provide accurate results for the purposes of the program. This includes both the reporting of results to Xcel Energy for demand-side management accounting and (if applicable) any necessary adjustments needed for third-party certification efforts approved by Xcel Energy as part of the scope of work on a particular project.

3.4.14 Excess Chiller Capacity

In the case that a design team has purposefully over-sized a mechanical system to accommodate expected future growth and that mechanical system would otherwise be eligible for prescriptive rebates from other programs offered by Xcel Energy, the following steps will be taken:

- The energy consultant will reduce the capacity of the system within the energy model to meet the modeled building load.
- The excess capacity (i.e. the difference in the capacity of the actual system and the theoretical system created for the energy model) will be treated as a separate piece of equipment with characteristics identical to those of the modeled equipment apart from capacity.

The excess capacity system will be subject to the current prescriptive rebates and deemed energy savings available at the time of the bundle meeting. These rebates and impacts will be absorbed by the EDA program (i.e. the prescriptive rebate is then added to the EDA rebate).

4. Reporting and Submissions

4.1 Simulation Outputs

The results shall include reporting of total annual energy cost in current dollars and also a cost breakdown by energy end-use (heating, cooling, service hot water, fans and pumps, lighting, refrigeration, and equipment). Similar output information shall be provided for all strategy, energy conservation measures (ECM) and bundle simulations.

The energy use shall be reported in total annual energy use per square foot and also a breakdown of energy use by end-use per square foot.

Total energy consumption shall be reported for all energy sources, e.g. total annual kWh electric energy use (kWh) and Dekatherms for energy gas use.

Peak energy use shall be reported for electric (kW), cooling (tons) and gas (kbtu/h). Peak electric kW is defined to occur between 9 am and 9 pm, excluding holidays, in the months of June thru September.

Emissions shall be reported in tons of CO_2 using the most recently provided average generation system emissions data from Xcel Energy provided in March of each year.

4.2 Simulation Inputs

Simulation inputs shall include the following:

- Description of any differences between the baseline and proposed models
- Description of energy analysis work done to quantify things that the simulation program was not capable of doing
    - Wall mass types and R-value
    - Glazing U factors and SHGC
    - Window-to-wall ratio
    - Wall areas by orientation
    - Glazing area by orientation
    - Roof R-values
    - Space type, floor area, and other design parameters
    - Space internal gains
    - Hourly space schedules
    - Lighting/equipment power densities
    - Full load equivalent hours of operation for lighting, equipment and occupancy
    - Mechanical (HVAC) system characteristics
    - Supply and outdoor ventilation air capacities
    - Supply and fan total static pressure

  - Service hot water system characteristics
  - Utility schedules
  - Weather (meteorological) data
  - Energy conservation measure descriptions

4.3 Project Reviews

Xcel Energy will perform project reviews on EDA projects. Four levels of reviews will be completed at random.

- All EDA Enhanced projects
- 10% of all projects below 1.5 GWh saved
- 40% of all projects between 1.5 GWh saved and 2 GWh saved
- 100% of all projects over 2 GWh saved

Once a project has been modeled at the schematic design phase and preliminary savings analysis numbers are known, the selection mechanism will identify whether or not the project will require an audit. The exception to this rule would include EDA Enhanced projects. These projects will initiate at the beginning of the process during the goal setting meeting. Reviews will initiate at this time. A description of review requirements follows.

4.3.1 Project Reviews below 1.5 GWh & EDA Enhanced projects

As part of the reviews, the EDA Energy Efficiency Engineer will be incorporated into the project team, and will be included in all related activity, including project meetings, correspondence, and verification activities.

4.3.2 Project Reviews over 1.5 GWh

As part of these reviews, the EDA Energy Efficiency Engineer will also review modeling parameters. As modeling parameters are specific to a given project and modeling software, the EDA Energy Efficiency Engineer will work with the Energy Consultant to obtain relevant information on a case-by-case basis. Below are a sampling of reports types that may be requested:

DOE 2 Reports (eQuest reports)

  - Report LV-B: Summary of Spaces
  - Report LV-D: Details of Exterior Surfaces in the Project
  - Report LS-C: Building Peak Load Components
  - Report LS-D: Building Monthly Loads Summary
  - Report SV-A: System Design Parameters (for all systems)
  - Report SS-A: System Loads Summary (for all systems)
  - Report SS-D: Building HVAC Load Summary
  - Report PS-A: Plant Energy Utilization
  - Report PS-B: Utility and Fuel Use Summary
  - Report PS-C: Equipment Loads and Energy Use
  - Report PS-E: Energy End-Use Summary for all Meters
  - Report BEPS: Building Energy Performance
  - Report BEPU: Building Utility
  - Report ES-D: Energy Cost Summary

  - Report ES-E: Summary of Utility-Rate

4.4 Measurement and Verification Requirements

4.4.1 Construction Document Review

a. Construction documents (CD) are reviewed for measures identified through the EDA process, and selected by the design team for implementation in the project. The design team and customer are notified whether or not these measures were found within these documents. Results should be modified at this time if changes in the following occur:

- Window area
- Ventilation rate
- Square-footage
- Space use
- Parking garage area
- Equipment modeled as part of the EDA analysis
- Daylight area

b. Proper documentation for lighting controls system is required to be provided in the CD set. A sequence of operations narrative and/or able can be used to further clarify the lighting controls operation of the space(s). Occupancy/Vacancy Sensor Control

Spaces where two or more zones of control are utilized shall have switchleg identification to clarify which lights are controlled by the sensor(s).

- Dual-level Control

  In spaces where two or more zones of control are utilized, the switches and light fixtures shall have switch leg identification to clarify which switch controls what set of lights.

Xcel Energy shall be provided with the Construction Document Review Report.

4.4.2 Project Verification Plan

The Energy Consultant shall provide a verification plan to Xcel Energy for review. This plan shall describe the extent of verification for the project.

4.4.3 On-site Verification Requirements

Site visit 1 - Shortly after construction completion, resolution of related commissioning items, and occupancy[6] (exceptions are made for certain building types such as jails, retail or hospitals), the Energy Consultant shall

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[6] Late 2011 this process was updated from the “two months” of occupancy requirement to allow for site visit 1 to be held closer to construction completion and occupancy to give design teams and controls contractors more time to fix problems for optimized strategies. Energy consultant will still complete full 2-4 weeks of data logging and determine any major changes affecting the project and/or Xcel Energy’s goals.

visit the project site and verify that specified measures were installed and functioning. Reasonable effort will be made to allow the Customer to repair measures that are found to be not functional before verification is complete. Dataloggers can be placed during site visit 1, but monitoring should begin (data loggers activated) after approximately 2 months after at least 80% occupancy[7].

Site visit 2 – A second site visit will be conducted to verify equipment installation and operation (if not fully completed in site visit 1 due to equipment not operating or installed at time), and to remove dataloggers.

Monitoring/datalogging:

Selected equipment and systems are monitored for a two-four week timeframe, as appropriate, to evaluate performance variables against modeling assumptions.

Monitoring should begin approximately 2 months after occupancy.

For projects where **individual measures** that have savings greater than or equal to 1.0 GWh or 20,000 Dth per year, data logging is required for a time period of **four** weeks. Less than 1.0 GWh or 20,000 Dth per year, data logging is required for a two week time period.

Fan energy use for variable volume systems will be verified through short-term (2 week) or long-term (4 week) trending to verify savings from reduced fan kW relative to the baseline.

Verified results:

Verify the operational hours with the design team. Provide the assumed modeled operation hours along with the verified operational hours prior to completing the verification.

The verified results shall be used to adjust the estimated savings to determine the final rebate. If the actual results are not within 15% of the as-specified energy savings (kWh or Dth) identified within the model finalized during CD review, the consultant completes an as-verified model to determine final energy savings.

Operation Hours
Weekday
Seasonal / Weekday Alternate
Weekend
Holiday

4.4.3 Reporting requirements

The following reports shall be provided to Xcel Energy in order to meet verification compliance:

- Construction Document Review
- Project Verification Plan
- Final Verification Report

A final verification report shall be provided to Xcel Energy and forwarded to the customer and design team as a last project deliverable.

Further, a final document for Xcel Energy must be included with the following data points:

- Date of Introductory Meeting
- Date of Bundle Meeting
- Dates of onsite verification

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[7] At least 80% occupancy is required because certain measures operate at maximum energy consumption based on occupants. Example- Laboratory fume hoods.

- Installation dates of equipment monitoring equipment
- Removal dates of equipment monitoring equipment

5. Professional Judgment

Certain modeling techniques and compliance assumptions applied to the proposed design(s) are fixed or restricted by the Xcel Energy Protocol. That is, there is no discretion to choose input values regarding specific input variables for compliance modeling purposes. However, there remain other aspects of computer modeling for which professional judgment is necessary. In those instances, it is important to verify whether a given assumption is appropriate.

Xcel Energy has full discretion to question the appropriateness of a particular input, especially if the user has not substantiated the value with supporting documentation.

Two questions may be asked in order to resolve whether good judgment has been applied and are taken from the *2005 Nonresidential Compliance Manual for California's Title 24:*

- Is the approach or assumption used in modeling the proposed design(s) consistent with the approach or assumption used in generating the baseline?
    - The rule is to model the proposed design(s) using the same assumptions and/or techniques used by the program to calculate the baseline unless drawings and specifications indicate specific differences that warrant conservation credit or penalties.
- Is a simplifying assumption appropriate for a specific case?
    - If simplification reduces the energy use of the proposed building when compared to a more explicit and detailed modeling assumption, the simplification is not acceptable.

Acknowledgement

The Energy Design Assistance Protocol was collaboration between several parties. These parties are acknowledged for presenting modeling ideas and input into this document.

- The Weidt Group®
- Group14 Engineering
- Xcel Energy

Appendix A: EDA/Custom Cross-Fuel/Combo-Fuel Project Policy

Background: This policy covers all EDA projects that involve a change in both electric and gas consumption. For projects that result in a change in consumption in other fuels – propane, heating oil, solar, etc. – the change in consumption for these fuels shall be treated as O&M impacts only.

EDA projects baseline choice to avoid cross-fuel

Baseline systems shall be selected to eliminate the situation where an end use's energy source is changed from one energy stream to a different energy stream in the bundle. Xcel must serve the fuel that is conserved and rebates must be paid from the program for that fuel to eliminate fuel-switching cases.

This policy addresses the following topics:

1. Definition of each of the possible Cross-Fuel/Combo-Fuel scenarios
2. Source BTU Analysis for Cross-Fuel
3. Screening for Cross-Fuel Analysis
4. Treatment of Achievements, Rebates, other Utility Costs
5. Treatment of Incremental Capital and O&M Costs or Savings

Significant policy points are **bolded.**

The MN DOC Docket No. G008/CIP-00-864.07 Reply Comments of May 23, 2003 state that Staff supports performing a BTU comparison for "determining whether a measure results in a net reduction in energy use." If a project does result in a net BTU savings, a "benefit-cost analysis that examines the changes in the specific fuels costs should also be conducted." The Docket does not address the treatment of achievements, rebates and Admin and Marketing costs.

Cross-Fuel / Combo-Fuel Scenarios

The possible scenarios include:

> *Cross-Fuel Project:* Reduced consumption for the primary, rebated fuel, increased consumption for the secondary fuel. Xcel must serve the fuel that is conserved and rebates must be paid from the program for that fuel to eliminate fuel-switching cases.
>
> *Full Combo Project:* Reduced consumption for both fuels and Xcel Energy serves both fuels.
>
> *Partial Combo Project:* Reduced consumption for both fuels but Xcel Energy serves only the primary fuel. Achievements are credited and rebates paid just for the primary fuel savings. The secondary fuel savings are treated as Incremental Energy O&M Savings in all tests.

Cross-Fuel Project Policy (Reduced consumption for the primary, rebated fuel, increased consumption for the secondary fuel)

Source BTU Analysis
For each cross-fuel project, the Source BTU Impacts from the two fuels should be combined to produce a Net Source BTU Savings. **For a project to be rebated, it must result in positive Net Source BTU Savings.**

To calculate the Source BTU Impacts, the following conversion factors are used. The MN DOC Docket No. G008/CIP-00-864.07 Reply Comments of May 23, 2003 state that Staff supports performing a BTU comparison for "determining whether a measure results in a net reduction in energy use." If a project does result in a net BTU savings, a "benefit-cost analysis that examines the changes in the specific fuels costs should also be conducted." The comments provide the following methodology to calculate the Source BTU savings resulting from each fuel:

Source BTU to Generator kWh

Source BTU Impact (Electric) = 7500 BTU/Generator kWh * Generator kWh, based on typical Heat Rate for Combined-Cycle Natural Gas-fired Plant

Efficiency of CC (Generator BTU / Source BTU) = BTU to kWh conversion (Generator BTU / Generator kWh) / Heat Rate of CC (Source BTU / Generator kWh)

Where,

BTU to kWh conversion (Generator BTU / Generator kWh) = 3412.3

1 BTU = 1.055 kilojoules. 1 joule per second = 1 watt, or 1 joule = 1 watt.sec.

1 kWh =1000 x 3600 watt.secs = 1000 x 3600 joules = 3600 kilojoules = 3600/1.055 BTU = 3412.3 BTU

Heat Rate of CC (Source BTU / Generator kWh) = 7500

Based on typical Heat Rate of 7500 BTU/kWh for CC's from Steve Wishart e-mail of 10/28/09.

Efficiency of CC (Generator BTU / Source BTU) = 3412.3 (Generator BTU / Generator kWh) / 7500 (Source BTU / Generator kWh) = 45.5% (Generator BTU/Source BTU)

This 45.5% efficiency value is slightly higher than the value estimated in the MN DOC Docket of 42%, reflecting the higher efficiency of newer combined-cycle natural-gas-fired plants.

Source BTU to Customer Dth

= BTU to Dth conversion (Source BTU / Source Dth) / (1 - Gas Line Loss Factor (Customer Dth / Source Dth))

Where,

BTU to Dth conversion (Source BTU / Source Dth) = 1,000,000

1,000,000 BTU = 1 MMBTU. 1 MMBTU = 1 Dth. 1,000,000 BTU = 1 Dth

Gas Line Loss Factor (Customer Dth / Source Dth) = 2%

Based on loss factor estimate form MN DOC Docket.

= 1,000,000 (Source BTU / Source Dth) / (1 - 98% (Customer Dth / Source Dth))
Source BTU Impact (Gas) = 1,020,408 Source BTU / Customer Dth * Customer Dth

Net Source BTU Savings

Net Source BTU Savings = Source BTU Impact (Primary Fuel Savings) - Source BTU Impact (Secondary Fuel Increase)

Screening for Cross-Fuel Analysis

Performing a Cross-Fuel Analysis means reducing the primary fuel savings by the secondary fuel increase according to the method specified above.

To perform a Cross-Fuel Analysis, the Source BTU Impacts of the fuel that has increased consumption must be greater than 10% of the Source BTU Impacts of the fuel that is being conserved. If the increased consumption is due to changes in a conditioned space, such as in a lighting project, a Cross-Fuel Analysis should not be performed. If the project does not qualify for Cross-Fuel analysis, the increased consumption shall be treated as an O&M cost. If the increased consumption is not due to changes in a conditioned space, unless the increased usage is produced by a renewable energy source, the project must be rejected, in accordance with Colorado Gas Rules – 4756(b):

> (b) Fuel switching. Fuel switching from natural gas to other fossil fuel derived energy sources shall not be included in the gas utility's DSM program. Programs to save natural gas through switching to renewable energy sources such as solar heating and ground source heat pumps are allowed.

The following equation shall be used to determine if the project qualifies for cross-fuel. If this equation is true, the project must go through cross-fuel analysis:

Source BTU Impact (Primary Fuel Savings) < 10 * Source BTU Impact (Secondary Fuel Increase)

To illustrate application of the cross-fuel rules, here are five general cases:

1. A large piece of machinery that uses electricity but also provides waste heat that is used in another process. If a high-efficiency electric option results in significant electric savings but also in a reduction in waste heat that must be made up with increased gas usage, and this increased gas usage exceeds 10% of the electric savings, the electric savings must be reduced by the gas usage increase. If the gas usage is less than 10% of the electric savings, the gas increase should be considered participant energy O&M costs.
2. A whole-building project which includes several electric energy-savings measures - such as windows, insulation, lighting, process loads - but results in net increase in gas usage, the electric savings must be reduced by the gas usage if the gas usage increase exceeds 10% of the electric savings. The gas usage increase can exclude for purposes of the adjustment calculation the measures which are changes in a conditioned space such as lighting controls, reduced lighting

design, and reduced plug load. This treatment provides an incentive to the customer to pursue more energy savings on the gas side. Because the electric rebate to the customer is discounted by the net gas increase, a reduction in this net gas increase would result in less of a discount, or a net increase in the rebate. If the gas usage is less than 10% of the electric savings, the gas increase should be considered participant energy O&M costs.

3. A large scale project to replace the lighting in a building results in an increase in gas usage due to lost heat that exceeds 10% of the electric savings on a source BTU basis. Because the increased usage is due to changes in a conditioned space, this project should treat the increased gas usage as a participant O&M cost and should not discount the electric savings or rebate. If the gas usage is less than 10% of the electric savings, the gas increase should be considered participant energy O&M costs.
4. An electric boiler is replaced by a gas boiler. This project is considered fuel-switching and is not allowed, even if it results in cost-effective source BTU savings, as the primary fuel being used changes as a result of the project.
5. A ground-source heat pump replaces a gas furnace. This project should go through cross-fuel analysis if the secondary fuel impacts are greater than 10% of the primary fuel impacts, and otherwise treat the secondary fuel impacts as participant energy O&M costs. This project is allowed in due to the exception made for fuel-switching involving renewable energy sources. (This situation usually doesn't apply in CO)

Also, when considering the revenue requirement impact of both fuels (avoided revenue requirements for saved fuel and increased revenue requirements for increased fuel) the project must be cost-effective.

Treatment of Achievements, Rebates and Other Utility Costs

For the fuel that is being conserved, the savings should be deducted by the fraction of the increased fuel's Source BTU Impact over the conserved fuel's Source BTU Impact. This percentage should then be applied to all aspects of the energy savings, including Marketing kW, Generator kW and Generator kWh on the electric side, and Dth on the gas side. This will result in a reduction of the rebate paid and the assumed other utility costs (administration and marketing costs). Net benefits are calculated from this reduced conservation of the rebated fuel, rather than from the net benefits of the two fuels.

Primary Fuel Savings Deduction = Source BTU Impact (Secondary Fuel Increase)
/ Source BTU Impact (Primary Fuel Savings)

Treatment of Incremental Capital and O&M Costs or Savings

The full Incremental Capital and non-energy O&MN Costs or Savings shall be used in the cost-effectiveness test and payback calculations. Payback calculations should use the bill savings based on the savings of the primary fuel and the increase in the consumption of the secondary fuel.

Full Combo Project Policy (Reduced consumption for both fuels and Xcel Energy serves both fuels.)

Treatment of Achievements, Rebates and Other Utility Costs

Full achievement credit shall be taken for the savings of both fuels. The rebates and other utility costs should be based on these achievements for each fuel. The Participant Test and payback estimates should be based on the bill savings and rebates paid from both fuels.

Treatment of Incremental Capital and O&M Costs or Savings

For the Participant Test and payback calculations, the full participant cost and O&M costs or savings from both fuels should be used. For the other test, the fuel's portion of the project's total avoided revenue requirements should be applied to the Incremental Capital and non-energy O&M Costs or Savings to produce the fuel's share of those costs or savings. There should not be any energy O&M impacts, as the impact of both fuels are captured.

Partial Combo Project Policy (Reduced consumption for both fuels but Xcel Energy serves only the primary fuel)

Treatment of Achievements, Rebates and Other Utility Costs

Achievement credit shall be taken only for the savings of fuel served by Xcel Energy. Rebates paid and other utility costs should be based only on the achievements of the fuel served by Xcel.

Treatment of Incremental Capital and O&M Costs or Savings

Internal Xcel: For TRC tests, the savings of the fuel not served by Xcel should be translated into avoided revenue requirements, and the incremental capital cost and any participant non-energy O&M costs or benefits shall be reduced so that they represent just the share of the avoided revenue requirements of the fuel served by Xcel. For the participant test, the full participant cost and non-energy O&M costs or savings from both fuels should be used. The bill savings from the fuel not served by Xcel shall be treated as bill savings.

Appendix B – Load Shifting

Policy Overview
This document outlines the policy for EDA projects with load shifting measures within Xcel Energy's Colorado service territory. This policy will ensure that load shifting projects are analyzed and accepted or rejected using a consistent decision-making methodology.

Definition
Load shifting shall be defined as a measure that shifts electrical energy and demand to an off-peak period, without reducing the total load served over a defined time period (for example, one day or one week). Energy consumption to meet the loads of the affected end use will not be significantly reduced. Example load shifting measures include thermal energy storage and equipment rescheduling.

Peak shaving and demand control technologies (for example, lighting voltage reduction) shall not be classified as load shifting if they reduce the total load being served.

Eligibility
Potential load shifting projects would have to meet all existing eligibility requirements of the applicable program (e.g. cost effectiveness requirements, payback criteria, customer eligibility, etc.). To address potential persistence issues surrounding load shifting measures, additional eligibility requirements include:

- A required capital investment in equipment - measures that are solely a function of change in behavior are ineligible (e.g. rescheduling manufacturing shifts), and
- Reasonable demonstration that savings persistence of at least 10 years is likely.

Load shifting projects will need to demonstrate persistence by meeting one or more of the following criteria:

- A minimum 3 year simple payback requirement - intent is to show the savings are significant enough that the customer would be motivated to continue the measure.
- A minimum estimated annual energy cost savings of $5,000. Supporting calculations should be provided during the application and pre-approval process.
- Customer shall provide written documentation stating the measure will be in place for at least 10 years.
- For unique technologies and situations, a demonstrated customer commitment to and adoption of the technology into current practices, as determined by Xcel Energy's project manager.

Appendix C - Occupancy Sensor Savings Tables

Dual level Occupancy Sensor Controls – to implement increase the reduction factors in the table below by 5% unless required in ASHRAE 90.1-2013 Table 9.6.1.

Building Type	Space Type	On-Peak Savings	Off-Peak Savings
Housing/ Hotel	Apartment/ Guest room/ Bedroom w/study	NA	NA
	Laundry	25%	40%
	Common Room	25%	29%

	Corridor[2]	20%	30%
	Exercise	25%	40%
	Lounge	25%	40%
	Guest Room Toilet	30%	60%
Hospital	Pharmacy	NA	NA
	Nursery	NA	NA
	Corridor	0%	30%
	Exam	25%	40%
	Lounge/ Waiting	15%	40%
	Patient/ OR/ ER/ Radiology	20%	30%
	OR Recovery	15%	30%
	Nursing Station	20%	40%
	Occu /Physical Therapy	20%	30%
	Procedure	25%	40%
Clinic	Waiting	15%	24%
	Exam	25%	40%
	Nurse Station	15%	15%
	Corridor[2]	0%	10%
	Procedure	25%	40%
	Physical Therapy	20%	30%
	Radiology	20%	30%
Manufacturing/ Warehouse	Warehouse[2]	20%	35%
	Manufacturing	0%	20%
Office	Conference[1]	25%	25%
	Corridor/ Atrium[2]	5%	3%
	Lobby[2]	5%	13%
	Data Center	25%	23%
	Dining	5%	19%
	Serving	5%	19%
	Kitchen	10%	20%
	Open Office	0%	9%
Religious	Audience/ Seating/ Pulpit/ Choir	15%	35%
Retail	Sales Floor	NA	NA
	Pharmacy	NA	NA
	Check Lines	NA	NA
	Vestibule	NA	NA
	Kitchen	NA	NA
	Grocery	0%	15%
	Corridor[2]	25%	32%

	Dining/ Serving	5%	23%
	Loading Dock	25%	25%
	Mech/ Elec	25%	40%
	Walk in Cooler/ Freezer	25%	40%
School (Primary)	Corridor[2]	20%	18%
	Laboratory	10%	12%
School (secondary)	Corridor[2]	20%	19%
School (Post Secondary)	Corridor[2]	15%	21%
	Library/ Media Center[4]	20%	32%
	Library stacks[2]	20%	32%
School (Generic)	Shop	15%	20%
	Gym	15%	23%
	Library/ Media Center	15%	9%
	Cafeteria/ Serving	5%	19%
	Kitchen	5%	25%
	Community Room	20%	28%
Generic/ All Other	Gym/ Fitness	15%	23%
	Day Care	10%	15%
	Garage/ Open Garage[3]	25%	6%
	Mech/ Elec	50%	70%
	Pool	20%	30%
	Conference[1]	25%	25%
	Open Office	0%	9%
	Corridor[2]	20%	30%
	Kitchen	10%	20%
	Dining/ Serving	5%	20%
	Break Room[1]	5%	20%
	Vestibule	NA	NA
	Storage[4]	10%	20%
	Stairwell[2]	20%	30%

1 Required unless multi-scene controls for space type
2 Beyond 50% control requirement
3 Beyond 30% control requirement
4 Storage rooms less than 1,000 SF